

## Resource discovery and the politics of fiscal decentralization

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Resource Discovery and the Politics of Fiscal Decentralization

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## Highlights

- Empirical analysis of the effect of natural resources on fiscal decentralization.
- Resource discovery has very little effect on revenue decentralization but induces expenditure centralization.
- Oil discovery the main driver of centralization and not mineral discovery.
- Resource discovery leads to centralization in countries without permanent democratization.
- Tax and intergovernmental transfers respond most to resource discovery and democratization whereas own source revenue, property tax, educational expenditure, and health expenditure do not seem to be affected.
- Higher resource rent leads to more centralization and the effect is moderated by democratization.

Sambit Bhattacharyya, Louis Conradie and Rabah Arezki<sup>2</sup>

19 February, 2017

**Abstract:** If the central government is a revenue maximizing Leviathan then resource discovery and democratization should have discernible impacts on the degree of fiscal decentralization. We systematically explore these effects by exploiting exogenous variation in giant oil and mineral discoveries and permanent democratization. Using a global dataset of 77 countries over the period 1970 to 2012 we find that resource discovery has very little effect on revenue decentralization but induces expenditure centralization. Oil discovery appears to be the main driver of centralization and not minerals. Resource discovery leads to centralization in locations which have not experienced permanent democratization. Tax and intergovernmental transfers respond most to resource discovery shocks and democratization whereas own source revenue, property tax, educational expenditure, and health expenditure do not seem to be affected. Higher resource rent leads to more centralization and the effect is moderated by democratization.

*JEL classification:* H41, H70, O11

*Key words:* Resource discovery; Resource rent; Democratization; Fiscal decentralization

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<sup>1</sup> We thank the editor Daniel Berkowitz and the two anonymous referees for their helpful comments. We gratefully acknowledge financial support from the Department of Economics, University of Sussex. We also acknowledge comments by and discussions with Roland Hodler, Rick van der Ploeg and the seminar participants at Oxford and Sussex. Maurizio Intartaglia provided excellent research assistance. All remaining errors are our own.

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# 1 Introduction

Haggling over a fair share of tax revenue between the central and the provincial governments is often an integral part of the political theatre in many countries. Natural resource revenue for its part plays a crucial role in influencing the politics of revenue sharing. Whether the issue at hand is fiscal federalism or autonomy or secession, the geographic location and the distribution of natural resource revenue seems to play a role. For example, the discovery of North Sea oil off the coast of Scotland has underpinned the Scottish case for sovereignty since the 1970s. North Sea oil was an integral part of the political discourse on either side of the Scottish independence referendum debate in the UK in 2015.<sup>3</sup> The same could also be said about the secession movement of the three mini Indian states of Jharkhand, Chhattisgarh and Uttarakhand. These three mini states split from the three large states of Bihar, Madhya Pradesh, and Uttar Pradesh respectively in the year 2000 and they also happen to be endowed with one of the largest mineral deposits in the country. Bolivian indigenous communities of the Aymaras and the Quechuas not receiving a fair share of the natural gas revenue sparked mass protests and political instability in the country which led to the nationalisation of gas fields in 2005.

In spite of the potential connections, research on the interrelationship between natural resources and fiscal decentralization remain rare. Standard models of fiscal decentralization assume benevolent governments at the central and regional levels (see Alesina and Spolaore, 1997; Oates, 1999; and Besley and Coate, 2003). They maximize the sum of utilities of residents in their jurisdiction and provide local public goods. Therefore, there is merit in fiscal decentralization or centralization depending on the nature of externality that the

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<sup>3</sup> On 25 August, 2015 Venessa Barford of the BBC writes in her article entitled *Scottish Independence: Five Unresolved Questions* for the BBC Online, “North Sea oil and gas reserves are another matter of much dispute. Mr Salmond says an independent Scotland would earmark a tenth of revenues - which the Yes campaign puts at about £1bn a year - to form a Norwegian-style sovereign wealth fund, creating a £30bn pot over a generation. Prime Minister David Cameron says the North Sea has been a British success story – and now oil and gas are getting harder to recover it's important to back the industry with the "broad shoulders" of the UK.”

provision of local public goods generates for other regions in the country. Alternatively, another class of models view fiscal decentralization from a ‘Neo-Hobbesian’ perspective whereby the central government is a revenue maximizing Leviathan only constrained by the constitution and bottom-up democratic pressure via the regional governments (Brennan and Buchanan, 1977). Under both of these approaches, one would expect the spatial distribution of natural resources and the quality of political institutions to matter by influencing the power relationship between the central and the regional governments. In particular, a revenue maximising Leviathan in the form of the central government is always expected to prefer fiscal centralization. However, their ability to achieve fiscal centralization could be constrained by democratic pressure and the capacity to tax. In spite of the potential connections, studying the effects of natural resources and political institutions on fiscal decentralization remains on the periphery of this literature.

In this paper we aim to systematically explore the causal effect of natural resources on fiscal decentralization and how the quality of political institutions affects this relationship. In particular, we exploit the exogenous variation in giant and supergiant discoveries in oil, gas and mineral reserves to set up a quasi-natural experiment to identify the effect of natural resources on fiscal decentralization. The effect of resource discovery as an exogenous news shock is analysed using a global dataset covering up to 77 countries over the period 1970 to 2012. Furthermore, the paper also estimates the effect of resource rent on fiscal decentralization.

The paper makes the following contributions. First, establishing causality is the main motivation in this literature and the paper presents a strategy to achieve that objective by using the exogenous news shock of resource discovery as an identifier. Second, the paper uses a novel geocoded dataset on resource discovery. In particular, the dataset is able to

distinguish between minerals<sup>4</sup> and oil discoveries. Third, the paper analyses the effect of resource discovery on the politics of fiscal decentralization. In particular, it explores how democratization influences the relationship between resource discovery and fiscal decentralization.

There is no obvious prior when it comes to the effect of natural resources on fiscal decentralization. On the one hand resource discovery could embolden a central government who is acting as a revenue maximizing Leviathan to act far more unilaterally and centralize fiscal affairs. On the other hand resource discovery could also incentivize the central government to decentralize in order to either expand political patronage or improve the efficiency of public spending by addressing the preference matching problem<sup>5</sup>. Therefore, the lack of a strong prior either way makes this a valid empirical question. Estimating a model controlling for country specific unobserved heterogeneity and trends, time varying common shocks, discovery history in the previous decade, GDP per capita, and heterogeneity in the measurement of fiscal decentralization we find that resource discovery (both oil and minerals) has very little effect on fiscal decentralization from the revenue side. However, the former appears to induce centralization on the expenditure side and the effect seems to be driven by oil discovery and not minerals. The intertemporal effect of resource discovery on revenue decentralization (measured by revenue share) appears to be statistically insignificant both 10 years pre-and-post discovery. However on the expenditure side we find evidence of expenditure concentration up to 6 years post discovery. We also document that permanent democratization and the quality of political institutions have a differential impact on the effect of resource discovery on fiscal decentralization. In particular, we find that resource discovery leads to fiscal centralization in locations which have not experienced permanent

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<sup>4</sup> The minerals are gold, silver, platinum group elements (PGE), copper, nickel, zinc, lead, cobalt, molybdenum, tungsten, uranium oxide.

<sup>5</sup> The preference matching problem refers to the mismatch in preference between the local population and the rest of the country with regards to public spending and revenue collection.



democratic transition. This effect is primarily driven by oil discovery. We note similar but statistically insignificant trends with mineral discovery. Which fiscal institutions respond most to the resource discovery news shock and democratization? We find that tax and intergovernmental transfers respond most to the shocks of resource discovery and democratization. The institutions of own source revenue, property tax, educational expenditure, and health expenditure do not seem to be significantly affected. The discovery news shock might affect government revenue and spending through expectations but any direct effects on revenue collection have to wait till the start of production. This is after accounting for the possibility of debt overhang as central governments can borrow post discovery. The marginal impact of resource rent could be much more immediate and direct. Using both the standard fixed effects model and the instrumental variable (IV) method we find higher resource rent leads to more fiscal centralization and the effect is moderated by permanent democratization. This pattern is observed for both oil and mineral rents even though the effect is albeit weak for the latter.

Our identification strategy relies on the exogenous variation in the discovery dates of giant and supergiant mineral and oil deposits.<sup>6</sup> Note that natural gas deposit discoveries are bundled with oil throughout the paper and referred to as ‘oil discovery’. Our dataset codes a mineral deposit as giant if it has the capacity to generate at least USD 0.5 billion of annual revenue for 20 years or more accounting for fluctuations in commodity price. A giant oil or/and gas (including condensate) field is a deposit that contains at least a total of 500 million barrels of ultimate recoverable oil or gas equivalent. This would be able to generate an annual revenue stream of approximately USD 0.4 billion under the assumptions that over the sample period the average gestation lag between production and discovery is 5 years, the average price of a barrel is USD 25, and the average discount rate including the country specific risk

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<sup>6</sup> Our identification strategy is similar to Cotet and Tsui (2013), Lei and Michaels (2014), and Arezki et al. (2014). These studies use giant oil discovery as an exogenous news shock to identify the effect of oil on conflict and other macroeconomic variables.

premium is 10 percent.<sup>7</sup> Therefore, it is reasonable to assume that both the giant oil and mineral discovery shocks are approximately of the same size on average. However, it is important to note that the value of discoveries are estimates and the projections are reliant on the estimation of the value at the time of the discovery. These estimates are often revised in subsequent years. The ultimately recoverable deposit could also change if there is a major shift in technology. Therefore, discoveries are better treated as exogenous news shock rather than a projection based expected revenue shock.

Geological data collected using modern equipment could locate with a finite margin of error the area where mineral or oil deposits are most likely to be found. However, it is not possible to accurately predict the timing of a giant or supergiant discovery. Giant and supergiant discoveries are rare and therefore, the discovery dates are likely to be exogenous. One might argue that politicians and the government could manipulate the announcement of the precise timing of discovery to gain political mileage. Both the Mike Horn dataset on oil discovery and the MinEx Consulting dataset on mineral discovery are immune to such possibilities as the reported discovery dates are independently verified and documented using multiple industry sources and not just government records.

Exploration effort could drive resource discovery in a country. We partially control for exploration effort by introducing a past discovery variable in our specification which accounts for any discovery of natural resources in that country during the previous decade. Exploration effort is likely to be positively correlated with past discovery. Furthermore, it is reasonable to expect that factors affecting the likelihood of resource discovery are either time-invariant or time-trending. Therefore, resource discoveries are likely to be exogenous conditional on our control vector of country fixed effects and linear trends. Nevertheless, we follow Cotet and Tsui (2013) and also control for wildcat drilling as a measure of exploration

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<sup>7</sup> Some studies claim that the risk premium augmented discount rate should be as high as 14-15 percent. Arezki et al. (2014) presents a more sophisticated analysis of net present value of giant oil discoveries and find that the median size of a giant discovery is approximately 5-6 percent of GDP.

intensity and our results are robust. Note that wildcat drilling is the number of oil wells drilled in an area where no oil production exists. The inclusion of wildcat drilling as an additional control reduces the sample size by more than half and therefore is not our preferred control variable. These results are reported in the Supplementary Material file.

Resource discovery could be driven by factors other than exploration effort. Hence, we estimate logit models with resource discovery as the dependent variable and find that no macroeconomic and political variables predict resource discovery. These issues are discussed further in section 3.

We interpret our result as an expectation induced fiscal regime shift following a discovery news shock. An alternative interpretation could be that resource discoveries trigger cash flow changes at the different levels of government and not fiscal decentralization. The latter interpretation depends on the assumption that countries with pre-existing decentralized fiscal framework would levy tax on natural resources at the sub-national level. Australia and Indonesia are examples of such fiscal arrangements. Even though plausible, such decentralized fiscal arrangements are not a norm in resource rich countries. In fact a large majority of the oil rich nations in the Middle East and North Africa, Northern Europe, Latin America, and Eastern Europe tax resource revenue at the national level. This suggests that the expectation induced fiscal regime shift interpretation is more likely. However, we are unable to empirically rule out the possibility of a cash flow effect.

The literature on natural resources and fiscal decentralization is surprisingly small even though one would expect natural resources to play a role in the bargaining game over fiscal control between the central and the provincial governments. However, there is a sizeable literature on the determinants of fiscal decentralization. This literature is dominated by cross-section studies, which identify numerous time-invariant determinants of fiscal

decentralization. These include colonial history, federal status, taste heterogeneity and geographical size. For example, Alesina et al. (1996) and Panizza (1999) presents theoretical models which identifies democracy; high income per capita; country size; and taste heterogeneity across regions within a country as determinants of fiscal decentralization. These predictions are then confirmed by regression model estimates using cross-section data. In contrast, Pommerehne (1977) and Bodman and Ford (2006) finds population density to be the main predictor of fiscal decentralization.

There is also a sizeable literature on the effectiveness of fiscal decentralization. For example, in a more recent study Enikolopov and Zhuravskaya (2007) test the effectiveness of fiscal decentralization on economic growth, quality of government, and public goods provision using cross-section and panel data from a sample of 75 developing and transitional economies over 25 years. Their work is an empirical test of the Riker (1964) theory that the results of fiscal decentralization depends on the degree of political centralization. Indeed they find empirical support for the Riker theory. In a related paper Blanchard and Shleifer (2001) examine the effect of fiscal federalism under political centralization.

Our paper is related to a large theoretical literature on fiscal decentralization. Lockwood (2005) presents an excellent survey of this literature. The standard model in this literature assumes that all levels of government are utility maximizing benevolent social planners. This approach is underpinned by the pioneering work of Oates (1972) and since developed by a number of authors. In contrast the political economy approach stems from the work of ‘Brennan and Buchanan’. They view the process of fiscal decentralization as the imposition of democratic control on the central government which is a revenue maximizing Leviathan.

In a related research Mulligan and Tsui (2015) examine the theoretical foundations of political competition and different shades of non-democracies. They show that leaders in

non-democracies are constrained by their ability to tax. Based on their model, one could very well envisage resource discovery to have an effect on the ability to tax in particular and fiscal decentralization in general.

Our paper is also related to a large literature on resource curse. This literature notes that resource rich countries on average grow much slower than resource poor countries<sup>8</sup>. Subsequent studies have argued that whether natural resources are a curse or a blessing depends on country-specific circumstances especially institutional quality (eg., Mehlum et al., 2006; Bhattacharyya and Hodler, 2010, 2014; Bhattacharyya and Collier, 2014), natural resource type (Isham et al., 2005) and ethnic fractionalisation (Hodler, 2006).

The remainder of the paper is structured as follows: Section 2 discusses the empirical strategy and data. Section 3 presents evidence on the effects of resource discovery and rent on fiscal decentralization. It also examines the intertemporal effects of resource discovery on fiscal decentralization, how democratization affects the relationship between resource discovery and fiscal decentralization, and any potential heterogeneity in the relationship across resource types (oil and minerals) and fiscal commitments (transfers, property tax, education, health etc.). Section 4 concludes.

## 2 Empirical Strategy

We use a panel dataset covering 77 countries observed over the period 1970 to 2012.<sup>9</sup> To estimate the effects of resource discovery on fiscal decentralization, we use the following model:

$$FD_{it+j} = \alpha_i + \beta_t + \lambda_t t + \theta_1 M_{it+j} + \gamma_1 RD_{it} + \gamma_2 YD10_{it} + \mathbf{X}_{it} \Gamma + \varepsilon_{it} \quad (1)$$

where  $FD_{it+j}$  is the fiscal decentralization variable in country  $i$  in the year  $t + j$ ,  $\alpha_i$  is the country fixed effects,  $\beta_t$  is a year dummy variable controlling for time varying common

<sup>8</sup> See van der Ploeg (2011) for a survey of this literature.

<sup>9</sup> Due to data limitations, not all specifications cover 77 countries. In most specifications, the panel is unbalanced. Appendix A1 presents a list of countries included in the sample.

shocks,  $\lambda_t$  are country specific time trends.  $M_{it+j}$  is a method dummy variable which takes the value 1 if the fiscal decentralization indicator is reported on accrual basis and 0 if it is reported using cash basis. The method dummy accounts for any potential systematic variation in the data due to the definition of fiscal decentralization. Note that  $RD_{it}$  is an indicator of resource discovery in country  $i$  in year  $t$  and  $YD10_{it}$  is the number of years with resource discoveries in the last ten years (from  $t-10$  to  $t-1$ ). The  $YD10_{it}$  variable accounts for the past history of discovery. In addition, country fixed effects and country specific trends also account for exploration effort as the factors affecting the likelihood of discovery are either time-invariant or time-trending. We control for additional covariates including GDP per capita. This is represented by the vector  $\mathbf{X}_{it}$ . We estimate this model for different leads and lags  $j$ , where in most cases  $j \in \{2, 4, 6, 8, 10\}$ .

We are primarily interested in the effect of a new giant discovery  $RD_{it}$  on  $FD_{it+j}$ . Our coefficient of interest is  $\gamma_1$  which presents the marginal effect of resource discovery on fiscal decentralization.

Our main dependent variable is fiscal decentralization  $FD_{it+j}$ . Fiscal decentralization refers to the degree of fiscal activity ceded by the central government to lower levels of government. Fiscal activity comprises of two main components: revenue and expenditure. Revenue captures the total cash inflow that pass through a given level of government, and expenditure captures the total cash outlay by a given level of government. The two components are closely related, with a correlation coefficient of 0.96. Given their importance, the existing literature tends to base their measures of fiscal decentralization on revenue and expenditure data. On the revenue side, we define the variable *Revenue Share* as the subnational share of total government revenue expressed in percentages. On the expenditure side the variable *Expenditure Share* is defined as the subnational share of total government

expenditure expressed in percentages. An increase in the share of subnational expenditure or revenue indicates a more decentralized fiscal system. Figures 1 and 2 presents a plot of the *Revenue and Expenditure Share* data respectively averaged over the sample period 1970-2012.

If the Neo-Hobbesian perspective of Brennan and Buchanan holds then we would expect resource discovery to encourage centralization and hence a negative and statistically significant  $\gamma_1$ . In contrast, in a standard model with benevolent governments one would expect that post resource discovery the central government would align fiscal affairs with local preferences and hence encourage decentralization. This would imply a positive and statistically significant  $\gamma_1$ .

Computing cross-nationally comparable fiscal indicators require data that breaks down general government into its different levels. Thus, we rely exclusively on the World Bank's *Database of Fiscal Decentralisation Indicators*, which constructs its measures using data from the IMF's *Government Finance Statistics (GFS)* database. The GFS provides a framework that distinguishes between three tiers of government; central, state or provincial, and local. This is an essential distinction in the decentralization context with the latter two tiers comprising the subnational level. The database is available from the World Bank's *Decentralization and Sub-National Regional Economics Thematic Group*, which has prepared over a dozen indicators, breaking down revenues and expenditures by type and function. This database provides a snapshot of state and local finances in 140 countries over the period 1970-2012.<sup>10</sup>

The GFS was originally prepared using the cash method of accounting. However, in 2001 it was recommended that the GFS should be prepared on an accrual basis in addition to

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<sup>10</sup> Note that some discrepancies between the raw data of the GFS and the indicators constructed by the World Bank's *Decentralization and Sub-National Regional Economics Thematic Group* were found. Thus, using the appropriate formulas, indicators were constructed using the GFS data where necessary.

the former method. This is due to the reality that, in practice, many macroeconomic datasets including national accounts in many countries is constructed using the accrual method. Accrual basis recording is a method in which “the time assigned to flows is when economic value is created, transformed, exchanged, transferred, or extinguished” (IMF, 2001). In contrast, for cash basis recording, the time assigned to flows is when cash is received or disbursed. This means that there are resource flows, for example, accounts payable including arrears, which would not be included in a cash accounting system. Our fiscal decentralisation indicators use observations with accrual basis reporting where possible, and cash basis in all other instances. As mentioned earlier, in equation 1 we also control for a method dummy variable  $M_{it+j}$  which takes the value 1 if the fiscal decentralization indicator is reported on accrual basis and 0 otherwise.

There are various ways of measuring revenues and expenditures, including as a whole, and as a percentage of GDP. Expenditures can be distinguished by their source of finance (for example, own-source revenues, subnational tax revenues or intergovernmental transfers); and by their sectors (for example, health and education). Furthermore, revenues can be broken down by source, for example, general tax and property tax. However, since decentralization is a relative concept, the most appropriate and widely used method is to measure the subnational proportion of the total government quantity (See for example: Davoodi and Zou, 1998; Panizza, 1999; Enikolopov and Zhuravskaya, 2007). Nevertheless we also use the other measures of decentralization as dependent variables in section 3.

We are well aware of the conceptual issues associated with the decentralization measures based on the GFS data. The GFS does not distinguish between delegated and devolved functions. Therefore the GFS may incorrectly attribute revenue sources and expenditure functions to subnational units even if they hold no discretion to determine expenditures and revenues, but instead simply receive and operate them. As such, one would



expect giant and supergiant resource discovery to be orthogonal to this type of measurement error. Therefore it is reasonable to expect the estimate of  $\gamma_1$  to be unaffected by measurement error of this nature.

Furthermore, the GFS aggregate the fiscal indicators across all subnational units within a single tier, thus it does not capture the horizontal differences across subnational governments within tiers. It also does not capture the number of subnational units within a country. For example revenue sources, expenditure responsibilities and fiscal autonomy may be distributed evenly across the entirety of the subnational jurisdictions, or they may be concentrated in one or two. These definitional issues are typically country specific and time invariant and hence are captured by the country fixed effects ( $\alpha_i$ ) in equation 1. Giant and supergiant resource discoveries are expected to be orthogonal to these definitional issues and hence the estimate of  $\gamma_1$  should remain unaffected.

Despite the definitional challenges, the GFS remains the most widely used and comprehensive data source on subnational finances, with the widest coverage of countries and time periods. It provides the best indicators available without significantly compromising data quality. It offers data with consistent definitions across countries and years, thus facilitating effective cross-national comparison.

Our main independent variable of interest is the resource discovery variable. Resource discovery is a binary variable taking the value 1 for giant oil or mineral discovery in a particular country-year and 0 otherwise. As it may be apparent from the definition above, the variable comprises of two components. First, it identifies country-years with the discovery of a giant oilfield. As we have mentioned earlier, a giant oil or/and gas (including condensate) field typically contains at least a total of 500 million barrels of ultimate recoverable oil or gas equivalent. Second, it identifies country-years with the discovery of a giant mine. A giant mineral deposit has the capacity to generate at least USD 0.5 billion of annual revenue for 20

years or more after accounting for fluctuations in commodity price. As we have discussed earlier, it is not possible to accurately predict the timing of a giant discovery. Political manipulation of the announcement of discovery dates is also unlikely in our dataset as the discovery dates are independently verified and documented using multiple independent sources (including industry sources) outside the control of the government.<sup>11</sup>

The giant oilfield discovery dates are sourced from Horn (2004) who also reports the geographic coordinates of these discoveries. Many recent notable studies of resource curse use this data source (see Lei and Michaels, 2014 and Arezki et al., 2014). The discovery dates of giant and major mineral deposits are sourced from MinEx Consulting which reports the geographic coordinates of such events over the period 1950 to 2012. Note that we also present estimates of oil and mineral discoveries separately in section 3.

In addition to the agenda of documenting the direct effects of resource discovery on fiscal decentralization, we are also interested in how democratization affects the relationship between resource discovery and fiscal decentralization. Hence, we estimate the following equation.

$$FD_{it} = \alpha_i + \beta_t + \lambda_i t + \beta_1 M_{it} + \beta_2 RD_{it} + \beta_3 D_{it} + \beta_4 RD_{it} \times D_{it} + \beta_5 YD10_{it} + \mathbf{X}_{it} \Gamma + \varepsilon_{it} \quad (2)$$

where  $D_{it}$  is the democratization variable in country  $i$  in the year  $t$ . We are primarily interested in how the quality of political institutions affects the relationship between new giant resource discovery  $RD_{it}$  and  $FD_{it}$ . Hence our coefficients of interest here are  $\beta_2$  and  $\beta_4$  as the marginal effect of resource discovery on fiscal decentralization in this specification is  $\beta_2 + \beta_4 D_{it}$  given the level of democratization.

We follow Giavazzi and Tabellini (2005), Bhattacharyya (2013), and Bhattacharyya and Hodler (2015) and code the democratization  $D_{it}$  variable as a treatment variable. The

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<sup>11</sup> Arezki et al. (2014) and Lei and Michaels (2014) presents a discussion on this issue.

democracy measure used to code the  $D_{it}$  treatment is the Polity2 score from the Polity IV database, which is described by Marshall and Jaggers (2002). This database reports democracy and autocracy scores, which both vary between 0 and 10 with 10 being the most democratic or most autocratic, respectively. The democracy score measures competition and openness in the electoral process, and the autocracy score measures suppression of competitiveness over executive recruitment, lack of constraints on the executive, and regulation of participation. The Polity2 score is the difference between democracy and autocracy scores which runs between -10 and +10. Following Giavazzi and Tabellini (2005) and Bhattacharyya and Hodler (2015) we define democratization  $D_{it}=1$  in a country if its POLITY2 score turns from negative to positive. One could argue that a positive POLITY2 score is too low a threshold for democratization as most permanent democratic transitions occur at higher scores. To account for the potential influence of a 0 threshold, we also test the robustness of our result with a democratization threshold of  $\text{POLITY2} = 5$  and find that the results are qualitatively unaffected.<sup>12</sup>

We consider three types of democratization: First, we consider democratization episodes that are not subsequently reversed. They are denoted by the treatment Democratization (permanent) in the result tables<sup>13</sup>. Second, we consider both temporary and permanent democratization episodes that last at least four years, as we expect that it takes time for democratic change to influence fiscal decentralization. They are denoted by the treatment Democratization (all) in the result tables. In situations where the democratic change last less than four years, we ignore such change and code it as if it did not occur. Furthermore, following Giavazzi and Tabellini (2005) we also discard democratic change that took place in the last three years of the sample. The Democratization variable in such situations is set to be missing. Third, we consider permanent democratization episodes that

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<sup>12</sup> Not reported here but are available upon request.

<sup>13</sup> For a full list of countries that experienced permanent democratization see Appendix A2.

took place before resource discovery.

One could argue that the actual revenue stream from natural resources is more important for fiscal decentralization than the resource discovery induced news shock. Therefore, it is worthwhile examining the effect of resource rent on decentralization. Hence we replace the resource discovery variable in equations (1) and (2) by resource rent and re-estimate the models.

The data on natural resource rents is obtained from the World Bank's *Changing Wealth of Nations Dataset*. The dataset covers 214 countries over the period 1970 to 2012. The rent obtained from a particular commodity is calculated as its world price minus the average extraction or harvesting cost, with both components measured in current US dollars. The unit rents are then multiplied by the physical quantities harvested or extracted by the country to give the total rents for the commodity. To construct total resource rents, we aggregate the rents of individual commodities for a country and a particular year, assuming zero values for missing data points on individual commodities. We then divide the resource rents by GDP (in current US dollars) and express them as a share. This is in line with several prominent empirical papers (see, Mehlum et al., 2006; and Bhattacharyya and Hodler, 2010). The variable captures the relative importance of resources in the domestic economy.

Normalizing the resource rent variable by GDP could introduce reverse causality challenges. Therefore, we instrument the resource rent variable by international commodity price. The international commodity price variable is sourced from a dataset by Burke and Leigh (2010). The authors construct an index for a commodity export bundle of 50 commodities - 35 of which are agricultural commodities and 15 non-agricultural commodities. To create the index, the authors obtain annual world commodity prices from the International Financial Statistics (IFS) database of the IMF, and deflate these prices using the export unit value. The deflated prices are then aggregated across the 50 commodities to

create an annual price index. These indices are arithmetically weighted using the 1995 commodity export shares to construct the country-specific commodity export price index.

Other variables used in the study are: oil and mineral rents and GDP per capita. The supplementary appendix reports summary statistics on the key variables and Appendix A3 presents detailed definition of variables.<sup>14</sup>

### 3 Evidence

#### *3.1 Do Economic and Political Factors Predict Resource Discovery?*

How random is the timing of resource discovery? To what extent economic and political factors influence the timing of giant resource discoveries? We test the predictive power of economic and political factors when it comes to the timing of resource discoveries. In particular, using a logit fixed effects model which also controls for year dummies and country specific linear trend we find that wildcat drilling, growth in GDP per capita lagged, international commodity price lagged, investment as a share of GDP lagged, government expenditure as a share of GDP lagged, and Polity 2 lagged have very little predictive power over the timing of giant resource discoveries. We find past discoveries positively predicts giant resource discoveries. This is consistent with Lei and Michaels (2014). These results are suggestive that the timing of giant and supergiant resource discoveries are largely orthogonal and on average are not affected by the underlying economic and political factors in the country.

#### *3.2 Natural Resource Discovery and Fiscal Decentralization*

Natural resource discovery could lead to fiscal decentralization under preference heterogeneity if both the central and provincial governments are utility maximizing benevolent actors acting on behalf of their citizens. Alternatively, it could also encourage

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<sup>14</sup>We also check for stationarity of the fiscal decentralization and resource rent variables using the Levin–Lin–Chu and the Harris–Tzavalis variety of unit root tests. Both tests account for bias emanating from cross-sectional association. We find these variables to be stationary.

centralization if the central government is revenue hungry and unconstrained. Therefore, the conflicting theoretical claims outlined above makes an open empirical question.

In table 1 we take the conflicting theories to the data and test our canonical empirical model outlined in equation 1 when  $j=0$  (ie., contemporaneous specification). Columns 1 – 3 use revenue share as the dependent variable which measures the subnational contribution to total government revenue. Higher subnational share of government revenue would imply more revenue decentralization. In a sample of 72 countries covering the period 1970 to 2012 we do not find any evidence of revenue centralization or decentralization. This no effect result is uniform across the type of resources – oil and minerals. However, the story is somewhat different when it comes to expenditure. Columns 4 – 6 examine the average effect of resource discovery on the subnational share of government expenditure. We find that resource discovery on average reduces the subnational share of expenditure by 1.93 percent. For example, the actual difference in the degree of expenditure decentralization between Japan and Germany over the period 1970 to 2012 is about  $(41.53 - 38.81) = 2.72$  percent. Therefore, to put this into perspective our model predicts if Japan discovers a giant or supergiant resource deposit then her subnational share of expenditure would decline and would be 71 percent close to the level of Germany. In columns 5 and 6 we test the effects of oil and mineral discovery and find that the centralization effect is driven by oil and not minerals.

Discovery precedes production and there is a significant lag between the two. Therefore, there is no new flow of revenue immediately after a discovery. This perhaps explains why the central government is not in a hurry to change revenue raising rules and hence the non-effect on revenue shares. In contrast, resource discovery promptly affects expectations and by association spending decisions of subnational governments. The statistically significant effects on expenditure share is perhaps indicative that central

governments promptly increase control over expenditure to prevent sub-national government overspend.

Discovery news shock is also likely to have a lasting effect. Hence, we look at the intertemporal effect of news shock in figure 3. The left hand panel presents intertemporal effects of resource discovery on the revenue share whereas the right hand panel focuses on the expenditure share. We trace any potential effect 10 years pre and post discovery. We find that the resource discovery news shock do now have any contemporaneous or lasting effect on the subnational share of revenue. However, we observe up to six years of statistically significant concentration in the subnational share of expenditure post discovery. This is suggestive that the spending decisions of the central government are more sensitive towards discovery news shocks than the revenue collection decisions. As stated above, a plausible explanation could be that the central government prefers to be in control of overall spending post discovery news shock to prevent subnational government overspend.

The lack of revenue centralization post 1970 could be due to oil rich countries having significant amount of discoveries in the 1960s or earlier. As a result they could already be highly revenue centralized before the start of our sample period. We do not have data on fiscal decentralization before 1970 to credibly comment on the degree of decentralization. However, we do have data on giant oil discovery dating back to 1962. Our data indicates that a large number of discoveries took place in the 1970s and late 1990s are also significant. Therefore, there is significant variation in our discovery data to track the marginal effect of discovery on fiscal decentralization.

### *3.3 The Political Economy of Natural Resource Discovery and Fiscal Decentralization*

As we have indicated earlier, the relationship between natural resources and fiscal decentralization could be influenced by the quality and nature of political institutions. In other words, if the central government is indeed revenue maximizing Leviathan then only

political constraints can prevent it from revenue grabbing. To test this theory in table 2 we introduce the interaction term between resource discovery and democratization variables. We follow Giavazzi and Tabellini (2005) and consider two types of democratization episodes based on the Polity2 measure. The first definition includes permanent democratization episodes (positive Polity2 score) only whereby the countries do not switch back to autocracy (negative or zero Polity2 score). Most post-Soviet Eastern European countries would fit this definition. The second definition includes both permanent and temporary democratization episodes. Temporary democratization is defined as countries switching to a positive Polity2 score for at least 4 years and then switching back to a negative score. Many developing countries in Latin America and Africa would fit this characterization. Using both forms of democratization treatment is perhaps useful to show that the interaction result is not sensitive to coding.

In column 1 we find that resource discovery reduces the subnational share of revenue by 5.7 percent but this concentration effect is reversed by permanent democratization. The net effect of the discovery news shock for countries that permanently democratized is  $6.86 - 5.70 = 1.16$  percent. In other words, permanently democratized countries respond to discovery news shock by decentralizing revenue collection. This pattern stays firm in column 2 when we replace the democratization (permanent) variable with democratization (all) albeit with a smaller magnitude of decentralization for the democratized countries. In column 3 we replace the democratization (all) measure with democratization (permanent) before resource discovery. This democratization variable codes permanent democratic transitions as 1 only if they occurred before the first resource discovery. This is to account for the possibility that democracy could be endogenous to oil discovery (Tsui, 2011). We observe similar pattern in the data. Columns 4 – 6 repeat the same experiment with subnational share of expenditure as



the dependent variable. We observe similar pattern in the data.<sup>15</sup>

One interpretation of the result is that resource discoveries trigger cash flow changes at the different levels of government and not fiscal decentralization. Countries with pre-existing decentralized fiscal framework are likely to levy tax on natural resources at the sub-national level. Therefore, a resource boom would appear like decentralization in our subnational fiscal share indicator even though no actual fiscal decentralization took place. This is unlikely to be the case here as discoveries are news shocks and do not trigger an immediate increase in cash flow. Furthermore, it is not entirely certain that resource rich countries would tax resource revenue at the sub-national level. Nevertheless, controlling for total government expenditure and taxation levels along with GDP levels would reduce the effects of a changing denominator of a sub-national fiscal share. We do that by explicitly controlling for total tax revenue, total government expenditure, and GDP levels and the coefficients of interest remain statistically significant exhibiting the same sign. These results are reported in the supplementary appendix.

Is this result driven by debt overhang as central government can borrow post discovery? Given that debt often follows a country specific trend, it is highly likely that our specification already controls for debt overhang. Nevertheless, we also explicitly control for debt overhang by replacing the country specific trend with log debt to GDP ratio and the results are unaffected.

In table 3 we go beyond the contemporaneous estimates reported in table 2 and test the timing of the effect of discovery news shock and the democratization shock on fiscal decentralization. The timing here is an important indicator of the agility of the legislative

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<sup>15</sup> We also present split sample estimates in the supplementary appendix. The results line up with the interaction estimates. Furthermore, we present estimates of interactions with presidential political systems, onshore resource discovery, and early industrializer dummy. None of these variables have any effect on the relationship between resource discovery and fiscal decentralization.

system post discovery news and democratization shocks. In other words, how rapidly the fiscal decentralization related legislative arrangements between central and regional governments change. We find that the statistical effect on fiscal decentralization endures 6 years after the shocks beyond which it turns statistically insignificant. This could imply that on average the fiscal arrangements change within 6 years of a discovery news shock. However, it could also be the result of a post-discovery cash flow effect. Such cash flow effect depend on the twin assumptions of giant discoveries entering production very quickly and the country in question taxes resource revenue at the sub-national level. Even though plausible, the latter seems to be unlikely as most resource rich (and especially oil rich) nations tax resource revenue at the national level. Nevertheless, we are unable to rule out a cash flow effect post discovery.

In table 4 we test whether the political economy effect is conditional on the type of natural resources. Our data allows us to distinguish between oil or/and gas and mineral discoveries. We find that the pattern is especially strong with oil and gas. Perhaps this is suggestive of the fact that petroleum resources are ‘point source’ and therefore much more decoupled from the rest of the economy. Hence, the news of oil bounty affects potential export revenue and the coffers of the central government more than provincial governments. Thus the central government exerts more control over oil driven potential revenue and expenditure. In contrast, minerals tend to be ‘diffuse’ and therefore much more linked to the rest of the economy and encourage both forward and backward linkages. Therefore, revenue and expenditure decisions in a mineral rich country could be much more evenly spread.

An alternative explanation could be that oil revenue is much more easily appropriable by central governments. Oil contracts often take the form of direct negotiations between the central government and large corporations. Furthermore, oil involves less backward and forward linkages with the rest of the economy and therefore it may end up having a muted

impact on the revenue expectations of the regional government relative to that of the central government. In contrast, mineral revenues are not as readily appropriable as oil and therefore the revenue consequences for the central and regional governments are lot less skewed.

To summarize, the pattern in the data is suggestive that resource discovery encourages centralization but additional democratic control on the central government could potentially reverse this pattern. This broadly fits with the theoretical paradigm that central governments prefer revenue centralization post resource discovery. However, their ability to do so is constrained by the nature of political institutions. Political competition in general and democratic institutions in particular restricts the ability of the central government to unilaterally impose taxes which gives rise to a more decentralized fiscal arrangement post resource discovery.

This leads us to the question of mechanism. We test whether resource discoveries lead to more military spending in non-democracies and thereby encouraging fiscal centralization. We do not find evidence in support of this thesis. A reasonable explanation could be that resource discoveries influence the power relation between central and regional governments. Under non-democratic political institutions these relationships are likely to be skewed in favor of the center. Resource discovery aids and abets that centralization process. This however is not that evident under democratic political institutions where the power relation between governments are likely to be less skewed.

#### *3.4 Which Fiscal Variables are affected by Resource Discovery and Democratization?*

Not all fiscal variables are directly linked to natural resources, thus they are unlikely to be affected by resource discovery. In table 5 we test whether there is any asymmetric effect of resource discovery on fiscal variables. In column 1 we specifically focus on tax revenue which is a subset of total government revenue. We use the subnational share of tax revenue as the dependent variable and find that the pattern observed in table 5 holds. Resource discovery

reduces subnational tax share by approximately 7.7 percent however this centralization effect is reversed in permanently democratized countries.

Transfers from the central government are a major source of revenue for the subnational governments. In column 2 we use intergovernmental transfers as a share of total subnational government's revenue. A high share of intergovernmental transfer would imply more decentralization as the central government is transferring more resources to the subnational government. We find that there is a significant asymmetry in the relationship between resource discovery and intergovernmental transfer share across the type of political institutions. Permanently democratized countries are more likely to transfer resources to the subnational governments post resource discovery with the share of intergovernmental transfers increasing on average by 2.2 percent. In contrast, on average the post discovery share declines in non-democracies by 2.9 percent.

In columns 3 and 4 we also examine the effects of resource discovery on the subnational governments own source revenue (as a share of total subnational expenditure) and subnational tax revenue (as a share of total subnational expenditure) respectively. A higher share of own source revenue or subnational tax revenue would signify more fiscal autonomy of the subnational government. We find similar asymmetric pattern in the data across permanently democratized countries and all others. However, the effect is statistically weak and only marginally significant in case of own source revenue.

In columns 5 – 7 we search for any potential heterogeneity across different types of taxes and expenditures. We have data on property tax, education expenditure, and health expenditure. Column 5 reports on the subnational share of total government property tax. One could reasonably expect a property or construction boom at the back of a giant resource discovery. Politicians could also engage in building more schools and hospitals expecting a potential resource windfall. Hence, we look at the effects of resource discovery on the

subnational shares of total government education and health expenditures in columns 6 and 7 respectively. We do not find any statistically significant effect even though a similar pattern in the data is demonstrated by the signs of the coefficients.

In summary, we find strong evidence of resource discovery news shock on subnational tax share and intergovernmental transfers. The effect is asymmetric as we find that faced with a resource discovery shock permanently democratized countries tolerate more fiscal autonomy than all other countries. We find weak or very little evidence of resource discovery and democratization affecting subnational governments own source revenue. Popular expectations command that resource discovery would trigger property boom and increased health and education spending. If this is indeed the case then we would observe resource discovery having an effect on property tax, education expenditure and health expenditure. We do not observe such patterns in the data.<sup>16</sup>

### *3.5 Resource Rent, Democratization and Fiscal Decentralization?*

So much for resource discovery. How about the effect of resource rent on fiscal decentralization? In table 6 we test the effect of resource rent and democratization on fiscal decentralization.

Resource rent is measured as a percentage share of GDP. In columns 1 – 5 of table 6 we look at the relationship between resource rent and the subnational share of total government revenue. Column 1 presents a linear fixed effects model and finds a statistically significant negative coefficient. As we have discussed earlier, the resource rent variable is potentially endogenous, thus in column 2 we use international commodity price as an instrument and estimate the model using the instrumental variable (IV) method. Following Burke and Leigh (2010) we argue that the effect of commodity prices on tax and spending shares in a resource-driven economy should work via resource rent. Therefore it is unlikely

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<sup>16</sup> The non-result in columns 3-7 of table 4 could be driven by sample attrition. Note that the sample size in these columns are smaller than columns 1 and 2.

that the commodity price instrument violates the exclusion restriction.<sup>17</sup> We find strong evidence of centralization. A 1 percentage point increase in resource rent decreases the subnational share of total government revenue by 0.9 percent. In column 3 we introduce the interaction term between resource rent and permanent democratization. We observe asymmetry in the relationship across permanently democratized countries and all others. For instance, higher resource rent still triggers centralization in permanently democratized countries albeit at a diminished magnitude of 0.7 percent. The centralization effect is much bigger for non-democratic countries averaging at 1.1 percent. In column 4 we use a somewhat flexible definition of democratization by including temporary democratization episodes in the dataset. The interaction term stays positive but is no longer statistically significant. In column 5 we replace the democratization measures by raw Polity 2 score. The same nonlinear pattern in the data remains. The threshold Polity 2 score for a zero or decentralization effect is 9. Columns 6 – 10 repeat the same tests with subnational share of total government expenditure as the dependent variable. The pattern observed in the data in columns 1 – 5 largely holds.

Table 7 tests whether the effect is uniform across oil and mineral rents and finds that the effect is largely uniform. However, the effect is statistically stronger in case of oil rent. Therefore, in summary the results observed with resource discovery as the key independent variable in tables 1 -4 is confirmed by using resource rent as the key independent variable in tables 5 – 6.

Through what mechanism resource rents affect fiscal decentralization? Rents could affect fiscal decentralization through both a routine cash flow as well as a genuine fiscal regime shift. A routine cash flow effect signifies an increase in the subnational share of

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<sup>17</sup> Furthermore, we also use the Conley et al. (2012) approach of plausible exogeneity. Even after considering  $\gamma \in [0, 1.5]$  we find the coefficient on ‘resource rent as a share of GDP’ to be  $[-1.13, 0.10]$ . This is different from the  $[-0.51, 0.10]$  interval under perfect instrument ( $\gamma \equiv 0$ ). However, under both priors on  $\gamma$  the coefficient stays negative in majority of cases leading us to conclude that the negative and significant effect of resource rent on fiscal decentralization is credible.

revenue following a resources boom if taxes on natural resources are levied at the local level. A regime shift in contrast would be a genuine change in the fiscal arrangements between the central and the subnational governments. Given that we are controlling for GDP per capita and country specific trend, our estimates in table 8 are more likely to be reflective of a fiscal regime shift. Furthermore, a fiscal regime shift is entirely plausible following permanent democratization and resource rent increase. This is confirmed by our estimates in table 8 where we notice that the effect of resource rent and democratization remain statistically significant up to two years after the shock. However, we are unable to rule out a routine cash flow effect from the increased rent following a resource boom.

#### 4 Concluding Remarks

This paper is motivated by several case studies that have drawn attention to the potential interplay between natural resources, political institutions and intergovernmental fiscal relations. It is also motivated by conflicting theoretical predictions. First, that resource discovery could embolden a central government who is acting as a revenue maximizing Leviathan to act far more unilaterally and centralize fiscal affairs. Second, resource discovery could also allow the central government to decentralize in order to either expand political patronage to stay in power or to improve the efficiency of public spending by addressing the preference matching problem. The objective of this paper is to offer an analysis of this topic by systematically analysing the effect of natural resources and political institutions on fiscal decentralization. The paper is also an attempt to address the causality challenge by using the exogenous news shock of giant oil and minerals discovery and the IV method as identifiers of the effects of natural resources on decentralization.

Estimating a model controlling for country fixed effects, year dummies, past discoveries, GDP per capita, and fiscal decentralization measurement definitions we find that resource discovery (both oil and minerals) has very little effect on the subnational share of

total government revenue. However, it reduces the subnational share of total government expenditure. Giant oil discovery appears to be driving this direct effect. There is very little evidence of intertemporal effect of resource discovery on revenue decentralization both 10 years pre-and-post discovery. However we find evidence of expenditure centralization up to 6 years post discovery. We also document asymmetry in the relationship. In other words, permanent democratization and the quality of political institutions exert a differential impact on the effect of resource discovery on fiscal decentralization. Permanently democratized countries seem to tolerate more subnational fiscal autonomy faced with a resource discovery news shock whereas for all other countries the trend is overwhelmingly in favour of centralization. This effect is predominantly driven by oil even though not limited to it. These effects are robust after controlling for wildcat drilling as a measure of exploration intensity.

Not all fiscal institutions respond identically to a resource discovery news shock. We find that tax and intergovernmental transfers respond most to the shocks of resource discovery and democratization. However, contrary to common expectations we do not find any evidence of discovery induced property boom or welfare spending (central government funded schools and hospitals) boom. The effect is largely similar when we switch to resource rent as the key explanatory variable and estimate the model using international commodity price as an IV.

The paper provides an insight into the intergovernmental fiscal relations in resource rich countries. Resource rich countries with more representative political institutions are far more likely to tolerate some degree of fiscal autonomy of the subnational governments. Resource rich countries with more centralized political institutions overwhelmingly prefer more centralized fiscal institutions. Whether a more decentralized fiscal model would improve development outcome across all countries is another matter better addressed elsewhere.



There is a large literature on the merits of fiscal decentralization. Even though related, we refrain from commenting on the merits of decentralization in resource rich countries here. That is another question for another day.

## Appendices

### A1. List of Countries in the Sample:

**Following countries are included in our specification of column 4, table 1.**

Albania, Argentina, Armenia, Australia, Austria, Azerbaijan, Belarus, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Congo, Rep., Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, El Salvador, Estonia, Ethiopia, Finland, France, Georgia, Germany, Greece, Honduras, Hungary, India, Indonesia, Iran, Islamic Rep., Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Rep., Latvia, Lesotho, Lithuania, Macedonia, FYR, Malaysia, Mauritius, Mexico, Moldova, Mongolia, Morocco, Netherlands, New Zealand, Nicaragua, Norway, Panama, Paraguay, Peru, Poland, Portugal, Romania, Russian Federation, Serbia, Slovak Republic, Slovenia, South Africa, Spain, Swaziland, Sweden, Switzerland, Thailand, Trinidad and Tobago, Turkey, Ukraine, United Kingdom, United States, Zimbabwe.

### A2. Countries and Years of Permanent Democratization:

**Always democratic or always non-democratic countries:**

Algeria, Australia, Austria, Azerbaijan, Bahrain, Belarus, Belgium, Botswana, Burkina Faso, Cameroon, Canada, China, Colombia, Democratic Republic of Congo, Republic of Congo, Costa Rica, Cote d'Ivoire, Cuba, Cyprus, Denmark, Dominican Republic, Ecuador, Egypt, Finland, France, Gabon, Gambia, Germany, Greece, Guinea, Haiti, Honduras, India, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Democratic People's Republic of Korea, Kuwait, Lebanon, Liberia, Malaysia, Morocco, Namibia, Netherlands, New Zealand, Norway, Oman, Pakistan, Papua New Guinea, Portugal, Qatar, Saudi Arabia, Sierra Leone, Singapore, Somalia, South Africa, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Syria, Togo, Trinidad and Tobago, Tunisia, Uganda, United Arab Emirates, United Kingdom, United States of America, Venezuela, Vietnam, Zimbabwe.

**Permanently democratic change events included in the sample (36):**

Albania (1997), Argentina (1983), Armenia (1998), Bolivia (1982), Brazil (1985), Bulgaria (1990), Chile (1989), Croatia (1999), Czech Republic (1990), El Salvador (1982), Estonia (1991), Ethiopia (1993), Georgia (1991), Hungary (1989), Indonesia (1999), Iran (1997), Republic of Korea (1987), Latvia (1991), Lithuania (1991), Mexico (1994), Moldova (1991), Mongolia (1990), Nicaragua (1990), Panama (1989), Paraguay (1989), Peru (1993), Poland (1989), Romania (1990), Russian

Federation (1992), Serbia and Montenegro (2000), Slovak Republic (1990), Slovenia (1991), Thailand (1992), Turkey (1983), Ukraine (1991).

### **A3. Number of Years with One or More Giant Oil Discoveries by Country:**

#### **Sample Period 1970-2003:**

Saudi Arabia (18), Iran (16), Norway (14), Indonesia (13), Australia (12), China (12), Brazil (11), Iraq (11), Nigeria (11), United States (11), United Kingdom (10), Mexico (9), Canada (6), Egypt (6), Malaysia (6), United Arab Emirates (6), Venezuela (6), Angola (5), Libya (5), Oman (5), Argentina (4), Colombia (4), India (4), Congo Rep. (3), Peru (3), Thailand (3), Algeria (2), Bolivia (2), Italy (2), Kazakhstan (2), Kuwait (2), Myanmar (2), Pakistan (2), Qatar (2), Sudan (2), Trinidad and Tobago (2), Tunisia (2), Yemen (2), Azerbaijan (1), Bangladesh (1), Brunei (1), Cote d'Ivoire (1), Denmark (1), Equatorial Guinea (1), Morocco (1), Netherlands (1), Papua New Guinea (1), Philippines (1), Romania (1), Russian Federation (1), Turkmenistan (1).

### **A4. Data Appendix:**

**Subnational Revenue Share:** It is the percentage of total revenues accounted for by sub-national governments, measured as the sum of local and state total revenues, excluding grants from state to local government, divided by the sum of local, provincial and national revenues. *Source:* Database of Fiscal Decentralization Indicators, The World Bank.

**Subnational Expenditure Share:** It is the percentage of total expenditures accounted for by sub-national governments, measured as the sum of local and provincial total expenditures, excluding grants from state to local government, divided by the sum of local, provincial and national expenditures, excluding intergovernmental transfers. *Source:* Database of Fiscal Decentralization Indicators, The World Bank.

**Subnational Share of Health Expenditure:** It is the percentage of total health expenditures accounted for by sub-national governments, measured as the sum of local and provincial health expenditures, divided by the sum of local, provincial and national health expenditures. *Source:* Database of Fiscal Decentralization Indicators, The World Bank.

**Subnational Share of Education Expenditure:** It is the percentage of total education expenditures accounted for by sub-national governments, measured as the sum of local and provincial education expenditures, divided by the sum of local, provincial and national education expenditures. *Source:* Database of Fiscal Decentralization Indicators, The World Bank.

**Subnational Share of Tax Revenue:** It is the percentage of total tax revenues collected by sub-national governments, measured as the sum of local and provincial tax revenues, divided by the sum of local, provincial and national tax revenues. *Source:* Database of Fiscal Decentralization Indicators, The World Bank.

**Subnational Share of Property Tax Revenue:** It is the percentage of total property tax revenues collected by sub-national governments, measured as the sum of local and provincial tax revenues, divided by the sum of local, provincial and national property tax revenues. *Source:* Database of Fiscal Decentralization Indicators, The World Bank.

**Intergovernmental Transfers:** It is the percentage of total subnational revenues and grants that is formed by transfers from other levels of government, measured as the sum of transfers received by local and provincial governments, divided by the sum of local and provincial revenues. *Source:* Database of Fiscal Decentralization Indicators, The World Bank.

**Subnational Own Source Revenue:** It is the percentage of expenditures financed with subnational governments' own source revenue, measured as the sum of local and state own source revenues minus grants received from grants or transfers from other levels of government, relative to total subnational expenditures. *Source:* Database of Fiscal Decentralization Indicators, The World Bank.

**Natural resource discovery:** Dummy variable taking the value one for at least one discovery of natural resources (giant oil/ mineral discoveries) in a country-year. *Source:* Horn (2004) and MinEx Consulting.

**Oil discovery:** Dummy variable taking the value one for at least one discovery of a giant oil reserve in a country-year. See section 1 and table footnotes for the definition of giant oil reserve. *Source:* Horn (2004).

**Mineral discovery:** Dummy variable taking the value one for at least one discovery of a giant mineral reserve in a country-year. See section 1 and table footnotes for the definition of giant mineral reserve and footnote 4 for a list of minerals included in the dataset. *Source:* MinEx Consulting.

**Resource Rents:** Total natural resource rents are the sum of oil rents, natural gas rents, coal rents (hard and soft) rents, mineral rents, and forest rents. Minerals consist of: bauxite, copper, lead, nickel, phosphate, tin, zinc, gold, silver, and iron ore. Rents are measured as a percentage share of GDP. *Source:* The World Bank.

**Polity2:** Democracy score measured by Polity2. *Source:* Polity IV dataset.

**Democratization (permanent / all):** Democratization=1 after democratization (i.e., Polity2 score turning positive). We consider two types of democratization: Treatments that are not subsequently reversed are denoted by "permanent" and treatments that last at least four years are denoted by "all". *Source:* Calculation based on Polity IV dataset.

**Method Dummy:** Method dummy = 1 if fiscal decentralization indicator is reported on accrual basis, and 0 if reported on cash basis.

**GDP per capita:** GDP per capita measured in PPP constant 2005 US dollars. , divided by total population. *Source:* The World Bank.

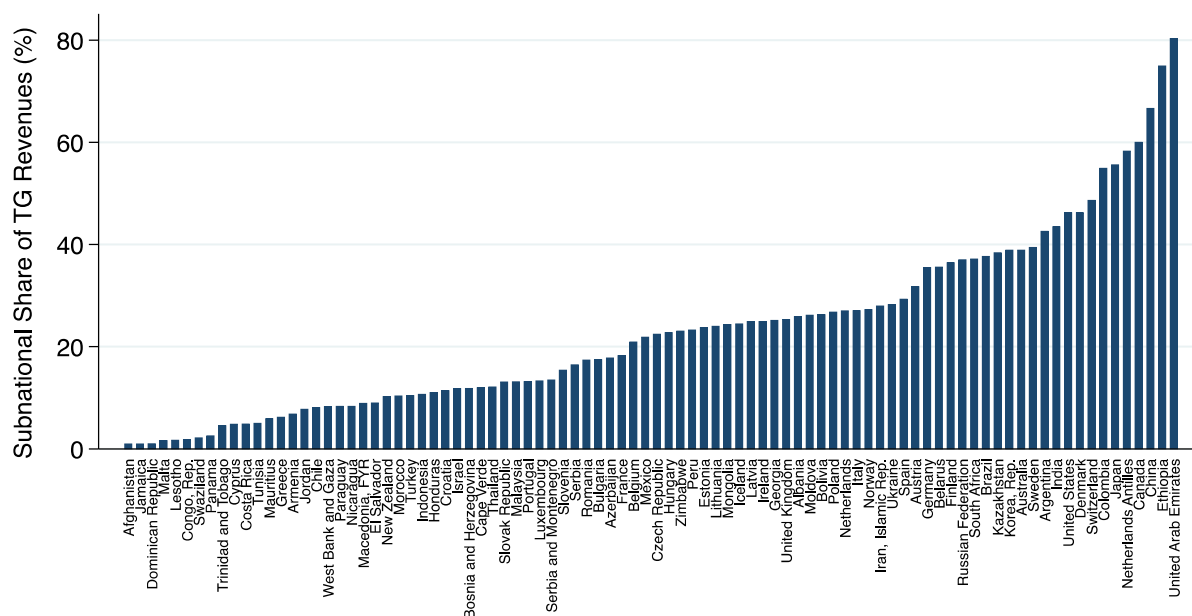
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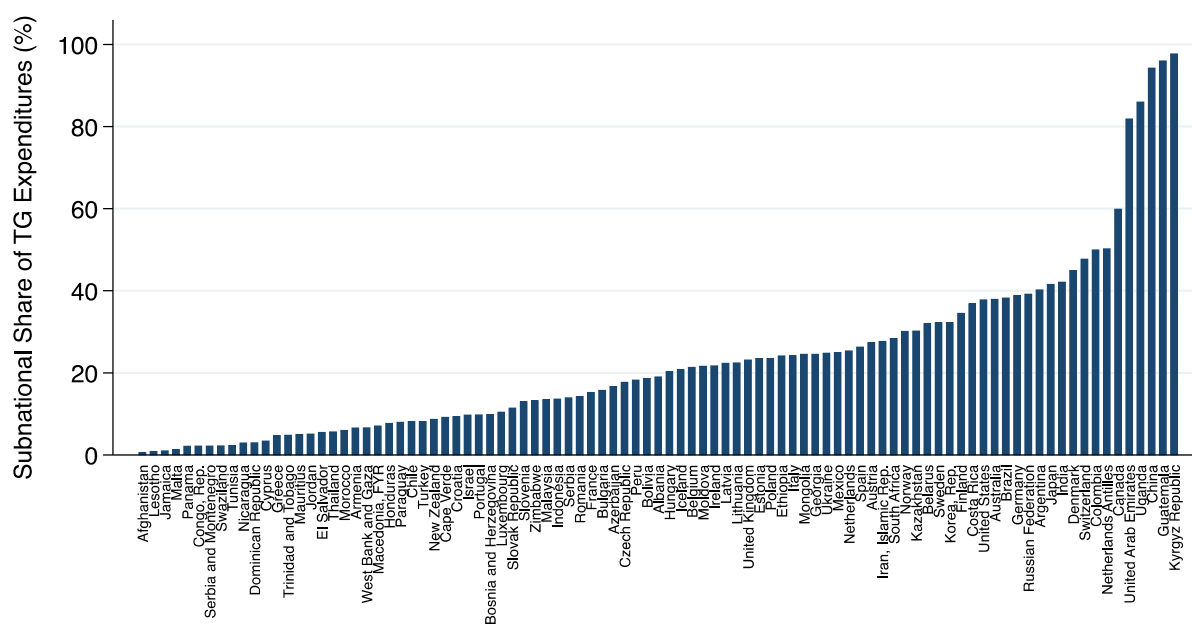
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Figure 1. Distribution of the Share of Subnational Revenue to Total Government Revenue



**Note:** Subnational Revenue share averaged over the period 1970-2012 expressed in percentage. *Source:* The World Bank, Database of Fiscal Decentralization Indicators.

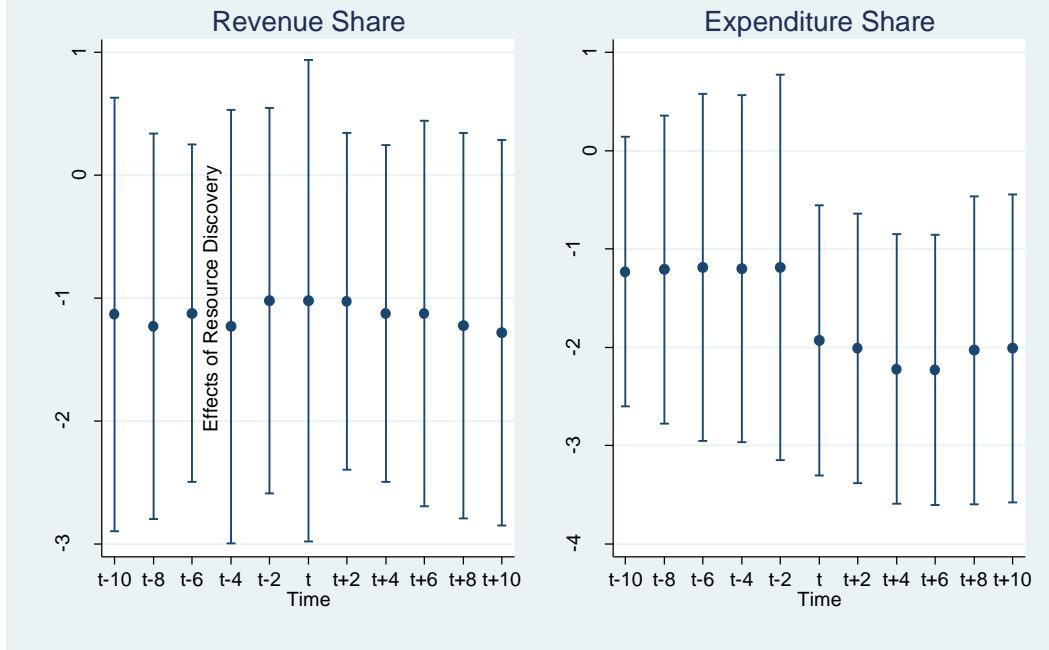
Figure 2. Distribution of the Share of Subnational Expenditure to Total Government Expenditure



**Note:** Subnational Expenditure share averaged over the period 1970-2012 expressed in percentage. *Source:* The World Bank, Database of Fiscal Decentralization Indicators.



Figure 3: The Intertemporal Effects of Resource Discovery on Fiscal Decentralization



**Notes:** The graphs show the timing of the Resource Discovery treatment effects on two different measures of fiscal decentralization. The resource discovery year here is  $t-j$  when  $j=0$ . The dependent variables (Revenue Share and Expenditure Share) are regressed on a dummy variable that takes the value 1 for  $j$  years before resource discovery where  $j \in \{-10, -8, -6, -4, -2, 0, 2, 4, 6, 8, 10\}$ . The number of years with resource discoveries in the last ten years ( $YD10_{it}$ ) is used as a control in all specifications. The dots show the point estimates, and the bars indicate 95% confidence intervals. Standard errors in the regressions are clustered and robust. All regressions include country fixed effects, year fixed effects, country specific trends, method dummy and GDP per capita.

TABLE 1.  
RESOURCE DISCOVERY AND FISCAL DECENTRALIZATION

VARIABLES	Revenue Share (1)	Revenue Share (2)	Revenue Share (3)	Expenditure Share (4)	Expenditure Share (5)	Expenditure Share (6)
Resource Discovery	-1.02 (1.00)			-1.93*** (0.70)		
Oil Discovery		-2.14 (1.31)			-2.30*** (0.90)	
Minerals Discovery			0.27 (0.73)			-0.80 (0.75)
<b>Controls</b>	Country Fixed Effects, Year Fixed Effects, Country Specific Trends, Method Dummy, Number of Discovery Years in the Last 10 Years, GDP per capita					
Observations	1118	1118	1118	1080	1080	1080
Countries	72	72	72	77	77	77
Adjusted R <sup>2</sup>	0.36	0.36	0.35	0.36	0.36	0.36

**Note:** Figures in parentheses give Driscoll-Kraay standard error. The Driscoll-Kraay standard errors are robust to arbitrary heteroscedasticity, arbitrary intra-group correlation and cross-sectional dependence. All regressions control for country fixed effects, year fixed effects, country specific linear trends, method dummy and GDP per capita. The method dummy variable assumes the value 1 if the observation for fiscal decentralization indicator for that country year is reported on accrual basis, and 0 if reported on cash basis. *Revenue Share*: subnational share of total government revenues (%). *Expenditure Share*: subnational share of total government expenditures (%). *Resource Discovery*, *Oil Discovery* and *Mineral Discovery* are dummy variables taking the value 1 for the discovery years and 0 otherwise. The discoveries here are giant discoveries only. Note that to qualify as a giant oilfield, it must contain ultimate recoverable reserves (URR) of at least 500 million barrels of oil equivalent. This data is from Horn (2004). To qualify as a giant mineral deposit, it must have the capacity to generate at least USD 0.5 billion of annual revenue for 20 years or more accounting for fluctuations in commodity price. This data is from Minex Consultancies. \*\*\*, \*\*, and \* indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. The Data Appendix describes all variables used.

TABLE 2.  
RESOURCE DISCOVERY, DEMOCRATIZATION AND FISCAL DECENTRALIZATION

VARIABLES	Revenue Share (1)	Revenue Share (2)	Revenue Share (3)	Expenditure Share (4)	Expenditure Share (5)	Expenditure Share (6)
Resource Discovery (RD)	-5.70** (2.60)	-6.13** (2.66)	-4.75** (2.41)	-8.58** (4.04)	-7.56** (3.01)	-7.40** (3.64)
Democratization (permanent)×RD	6.86** (2.76)			8.85** (4.25)		
Democratization (all)×RD		6.74** (2.66)			7.61** (3.74)	
Democratization (permanent) before RD × RD			5.81** (2.56)			7.70** (3.80)
<b>Controls</b>	Country Fixed Effects, Year Fixed Effects, Country Specific Trends, Method Dummy, Number of Discovery Years in the Last 10 Years, GDP per capita, Democracy Variables					
Observations	1056	1056	1056	1061	1061	1061
Countries	69	69	69	74	74	74
Adjusted R <sup>2</sup>	0.38	0.41	0.38	0.39	0.42	0.39

**Note:** Figures in parentheses give Driscoll-Kraay standard errors. The Driscoll-Kraay standard errors are robust to arbitrary heteroscedasticity, arbitrary intra-group correlation and cross-sectional dependence. All regressions control for country fixed effects, year fixed effects, country specific linear trends, method dummy and GDP per capita. The method dummy variable = 1 if fiscal decentralization indicator is reported on accrual basis, and 0 if reported on cash basis. *Revenue Share*: subnational share of total government revenues (%). *Expenditure Share*: subnational share of total government expenditures (%). *Resource Discovery* is a dummy variable taking the value 1 for the discovery years and 0 otherwise. The discoveries here are giant discoveries only. Note that to qualify as a giant oilfield, it must contain ultimate recoverable reserves (URR) of at least 500 million barrels of oil equivalent. This data is from Horn (2004). To qualify as a giant mineral deposit, it must have the capacity to generate at least USD 0.5 billion of annual revenue for 20 years or more accounting for fluctuations in commodity price. This data is from Minex Consultancies. *Democratization*=1 after democratization (i.e., Polity2 score turning positive). We consider two types of democratization: Treatments that are not subsequently reversed are denoted by "permanent", and treatments that last at least four years are denoted by "all". \*\*\*, \*\*, and \* indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative.

TABLE 3.  
RESOURCE DISCOVERY, DEMOCRATIZATION AND FISCAL DECENTRALIZATION: TIMING OF RESPONSE

VARIABLES	Revenue Share [t+2] (1)	Revenue Share [t+4] (2)	Revenue Share [t+6] (3)	Revenue Share [t+7] (4)	Expenditure Share [t+2] (5)	Expenditure Share [t+4] (6)	Expenditure Share [t+6] (7)	Expenditure Share [t+7] (8)
Resource Discovery (RD) <sub>t</sub>	-7.98*** (1.19)	-5.33*** (1.22)	-4.23*** (1.21)	-2.30* (1.20)	-9.76*** (1.40)	-7.45*** (1.40)	-5.41*** (1.27)	-2.59* (1.10)
Democratization (permanent) <sub>t</sub> × RD <sub>t</sub>	8.42*** (1.41)	4.77*** (1.47)	2.76* (1.47)	0.81 (1.49)	9.85*** (1.59)	7.40*** (1.63)	4.91*** (1.49)	5.08 (5.53)
<b>Controls</b>	Country Fixed Effects, Year Fixed Effects, Country Specific Trends, Method Dummy, Number of Discovery Years in the Last 10 Years, GDP per capita, Democratization (permanent)							
Observations	1043	1017	985	967	1005	982	950	931
Countries	69	69	69	69	74	74	74	74
Adjusted R <sup>2</sup>	0.36	0.32	0.33	0.33	0.37	0.35	0.37	0.38

**Note:** Figures in parentheses give Driscoll-Kraay standard errors. The Driscoll-Kraay standard errors are robust to arbitrary heteroscedasticity, arbitrary intra-group correlation and cross-sectional dependence. All regressions control for country fixed effects, year fixed effects, country specific linear trends, method dummy and GDP per capita. The method dummy variable = 1 if fiscal decentralization indicator is reported on accrual basis, and 0 if reported on cash basis. *Revenue Share*: subnational share of total government revenues (%). *Expenditure Share*: subnational share of total government expenditures (%). *Resource Discovery* is a dummy variable taking the value 1 for the discovery years and 0 otherwise. The discoveries here are giant discoveries only. Note that to qualify as a giant oilfield, it must contain ultimate recoverable reserves (URR) of at least 500 million barrels of oil equivalent. This data is from Horn (2004). To qualify as a giant mineral deposit, it must have the capacity to generate at least USD 0.5 billion of annual revenue for 20 years or more accounting for fluctuations in commodity price. This data is from Minex Consultancies. *Democratization*=1 after democratization (i.e., Polity2 score turning positive). We consider one type of democratization: Treatments that are not subsequently reversed are denoted by "permanent". \*\*\*, \*\*, and \* indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative.

TABLE 4.  
OIL & MINERAL DISCOVERY AND THE POLITICS OF FISCAL DECENTRALIZATION

VARIABLES	Revenue Share (1)	Revenue Share (2)	Expenditure Share (3)	Expenditure Share (4)
Oil Discovery (OD)	-6.98** (3.86)		-11.47*** (1.75)	
Mineral Discovery (MD)		-2.25 (1.68)		-2.86 (2.73)
Democratization (permanent)×OD	7.24** (4.04)		12.62*** (2.01)	
Democratization (permanent)×MD		3.61* (1.78)		2.69 (2.59)
<b>Controls</b>	Country Fixed Effects, Year Fixed Effects, Country Specific Trends, Method Dummy, Number of Discovery Years in the Last 10 Years, GDP per capita, Democratization (permanent)			
Observations	1056	1056	1016	1016
Countries	69	69	74	74
Adjusted R <sup>2</sup>	0.32	0.37	0.40	0.37

**Note:** Figures in parentheses give Driscoll-Kraay standard errors. The Driscoll-Kraay standard errors are robust to arbitrary heteroscedasticity, arbitrary intra-group correlation and cross-sectional dependence. All regressions control for country fixed effects, year fixed effects, country specific linear trends, method dummy and GDP per capita. The method dummy variable = 1 if fiscal decentralization indicator is reported on accrual basis, and 0 if reported on cash basis. *Revenue Share*: subnational share of total government revenues (%). *Expenditure Share*: subnational share of total government expenditures (%). *Oil Discovery* and *Mineral Discovery* are dummy variables taking the value 1 for the discovery years and 0 otherwise. The discoveries here are giant discoveries only. Note that to qualify as a giant oilfield, it must contain ultimate recoverable reserves (URR) of at least 500 million barrels of oil equivalent. This data is from Horn (2004). To qualify as a giant mineral deposit, it must have the capacity to generate at least USD 0.5 billion of annual revenue for 20 years or more accounting for fluctuations in commodity price. This data is from Minex Consultancies. *Democratization*=1 after democratization (i.e., Polity2 score turning positive). We consider “permanent” democratization here whereby the treatments are not subsequently reversed. \*\*\*, \*\*, and \* indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. The Data Appendix describes all variables used.

TABLE 5.  
WHICH FISCAL VARIABLES ARE AFFECTED BY RESOURCE DISCOVERY AND DEMOCRATIZATION?

VARIABLES	TaxShare (1)	TraShare (2)	ExpOwn (3)	ExpTax (4)	PTax (5)	Eexp (6)	HeExp (7)
Resource Discovery (RD)	-7.67*** (2.46)	-2.91** (1.38)	-4.04 (3.12)	-1.43 (2.45)	-4.09 (3.56)	-2.36 (2.11)	-4.70 (5.84)
Democratization (permanent)×RD	7.87*** (2.43)	5.06*** (1.25)	6.96* (3.66)	1.54 (2.26)	4.67 (4.15)	0.79 (3.20)	3.57 (5.76)
<b>Controls</b>	Country Fixed Effects, Year Fixed Effects, Country Specific Trends, Method Dummy, Number of Discovery Years in the Last 10 Years, GDP per capita, Democratization (permanent)						
Observations	1118	1646	863	981	725	474	435
Countries	69	91	72	76	58	48	48
Adjusted R-squared	0.36	0.408	0.59	0.55	0.60	0.49	0.53

*Note:* Figures in parentheses give Driscoll-Kraay standard errors. The Driscoll-Kraay standard errors are robust to arbitrary heteroscedasticity, arbitrary intra-group correlation and cross-sectional dependence. All regressions control for country fixed effects, year fixed effects, country specific linear trends, method dummy, democratization, and GDP per capita. The method dummy variable = 1 if fiscal decentralization indicator is reported on accrual basis, and 0 if reported on cash basis. *Resource Discovery* is a dummy variable taking the value 1 for the discovery years and 0 otherwise. The discoveries here are giant discoveries only. Note that to qualify as a giant oilfield, it must contain ultimate recoverable reserves (URR) of at least 500 million barrels of oil equivalent. This data is from Horn (2004). To qualify as a giant mineral deposit, it must have the capacity to generate at least USD 0.5 billion of annual revenue for 20 years or more accounting for fluctuations in commodity price. This data is from Minex Consultancies. *Democratization*=1 after democratization (i.e., Polity2 score turning positive). We consider “permanent” democratization here whereby the treatments are not subsequently reversed. The dependent variables are defined as follows: *TaxShare*: subnational share of total government tax revenue. *TraShare*: intergovernmental transfers as a share of total subnational government revenue. *ExpOwn*: subnational government own source revenue as a share of total subnational expenditures. *ExpTax*: subnational tax revenue as a share of total subnational expenditures. *PTax*: Subnational share of total government property tax. *Eexp*: subnational share of total government education expenditures. *HeExp*: subnational share of total government health expenditures. \*\*\*, \*\*, and \* indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. The Data Appendix describes all variables used.

TABLE 6.  
RESOURCE RENT, DEMOCRATIZATION AND FISCAL DECENTRALIZATION

VARIABLES	SUBNATIONAL SHARE OF TOTAL GOVERNMENT REVENUES (%)						SUBNATIONAL SHARE OF TOTAL GOVERNMENT EXPENDITURES (%)			
	OLS	IV	OLS	OLS	OLS	OLS	IV	OLS	OLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Resource Rent (RR)	-1.06*** (0.29)	-0.91*** (0.22)	-1.14*** (0.32)	-0.89*** (0.26)	-0.90*** (0.23)	-1.15*** (0.30)	-0.78*** (0.20)	-1.24*** (0.33)	-0.96*** (0.30)	-0.96*** (0.28)
Democratization (permanent)×RR			0.38** (0.19)					0.44* (0.24)		
Democratization (all)×RR				0.44 (0.45)					0.35 (0.41)	
Polity2 × RR					0.10*** (0.28)					0.10*** (0.02)
<b>Controls</b>	Country Fixed Effects, Year Fixed Effects, Country Specific Trends, Method Dummy, GDP per capita, Democracy Variables									
Instrumental Variable (IV)		Int. comm. price					Int. comm. price			
F-Stat IV Relevance		55.5					56.6			
Underidentification		3.96					3.79			
Observations	1112	1112	1050	1050	1050	1073	1073	1009	1009	1009
Countries	72	72	69	69	69	77	77	74	74	74
Adjusted R <sup>2</sup>	0.49		0.50	0.52	0.54	0.51		0.53	0.54	0.55

Note: Figures in parentheses give Driscoll-Kraay standard errors. The Driscoll-Kraay standard errors are robust to arbitrary heteroscedasticity, arbitrary intra-group correlation and cross-sectional dependence. All regressions control for country fixed effects, year fixed effects, country specific linear trends, method dummy, democratization, and GDP per capita. The method dummy variable = 1 if fiscal decentralization indicator is reported on accrual basis, and 0 if reported on cash basis. *Resource Rent* is defined as the total resource rents to GDP. *Democratization*=1 after democratization (i.e., Polity2 score turning positive). We consider two types of democratization: Treatments that are not subsequently reversed are denoted by “permanent”, and treatments that last at least four years are denoted by “all”. All regressions include an intercept. *F-Stat IV Relevance* provides the Kleibergen-Paap rk Wald F statistic on the excluded instrument from the first-stage regression. The statistic must exceed 10 for the instrument to be of sufficient strength. *Underidentification* provides the Kleibergen-Paap rk LM statistic for underidentification. The statistic must exceed 3.8 to reject the null hypothesis of an equation that is underidentified (5% level). \*\*\*, \*\*, and \* indicate significance level at 1%, 5%, and 10% respectively.

TABLE 7.  
OIL AND MINERAL RENT, DEMOCRATIZATION AND FISCAL DECENTRALIZATION

VARIABLES	Revenue Share (1)	Revenue Share (2)	Expenditure Share (3)	Expenditure Share (4)
Oil Rent (OR)	-1.20*** (3.86)		-1.31*** (0.07)	
Mineral Rent (MR)		-0.56* (0.31)		-0.91** (0.37)
Democratization (permanent)×OR	0.38** (0.19)		0.42*** (0.13)	
Democratization (permanent)×MR		0.43 (0.49)		1.01* (0.56)
<b>Controls</b>	Country Fixed Effects, Year Fixed Effects, Country Specific Trends, Method Dummy, GDP per capita, Democratization (permanent)			
Observations	1050	1050	1009	1009
Countries	69	69	74	74
Adjusted R <sup>2</sup>	0.50	0.37	0.53	0.37

**Note:** Figures in parentheses give Driscoll-Kraay standard errors. The Driscoll-Kraay standard errors are robust to arbitrary heteroscedasticity, arbitrary intra-group correlation and cross-sectional dependence. All regressions control for country fixed effects, year fixed effects, country specific linear trends, method dummy and GDP per capita. The method dummy variable = 1 if fiscal decentralization indicator is reported on accrual basis, and 0 if reported on cash basis. *Revenue Share*: subnational share of total government revenues (%). *Expenditure Share*: subnational share of total government expenditures (%). *Oil Rent* is defined as the total oil and gas rents to GDP. *Mineral Rent* is defined as the mineral rent to GDP. *Democratization*=1 after democratization (i.e., Polity2 score turning positive). We consider "permanent" democratization here whereby the treatments are not subsequently reversed. \*\*\*, \*\*, and \* indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. The Data Appendix describes all variables used.



TABLE 8.  
RESOURCE RENT, DEMOCRATIZATION AND FISCAL DECENTRALIZATION: TIMING OF RESPONSE

VARIABLES	Revenue Share [t+2] (1)	Revenue Share [t+4] (2)	Expenditure Share [t+2] (3)	Expenditure Share [t+4] (4)
Resource Rent (RR <sub>t</sub> )	-0.88*** (0.08)	-0.45*** (0.09)	-0.97*** (0.08)	-0.45*** (0.11)
Democratization (permanent) <sub>t</sub> × RR <sub>t</sub>	0.39** (0.17)	-0.03 (0.18)	0.46*** (0.17)	-0.003 (0.19)
<b>Controls</b>	Country Fixed Effects, Year Fixed Effects, Country Specific Trends, Method Dummy, GDP per capita, Democratization (permanent)			
Observations	1039	999	998	962
Countries	69	69	74	74
Adjusted R <sup>2</sup>	0.40	0.34	0.42	0.33

**Note:** Figures in parentheses give Driscoll-Kraay standard errors. The Driscoll-Kraay standard errors are robust to arbitrary heteroscedasticity, arbitrary intra-group correlation and cross-sectional dependence. All regressions control for country fixed effects, year fixed effects, country specific linear trends, method dummy and GDP per capita. The method dummy variable = 1 if fiscal decentralization indicator is reported on accrual basis, and 0 if reported on cash basis. *Revenue Share*: subnational share of total government revenues (%). *Expenditure Share*: subnational share of total government expenditures (%). *Resource Rent* is defined as the total resource rents to GDP. *Democratization*=1 after democratization (i.e., Polity2 score turning positive). We consider “permanent” democratization here whereby the treatments are not subsequently reversed. \*\*\*, \*\*, and \* indicate significance level at 1%, 5%, and 10% respectively against a two sided alternative. The Data Appendix describes all variables used.